

THE INVENTION CLAIMED IS:

1. A method of transferring molecules of interest from an electrophoretic polymer gel to a MALDI target plate comprising the steps of:

(i) providing an electrophoretic gel containing one or more molecules of interest;

(ii) replacing water within the electrophoretic gel with a cosolvent mixture;

(iii) positioning a pin over the gel and penetrating the gel with the pin;

(iv) energizing the pin to deplete the gel in a region surrounding the one or more molecules of interest, causing the cosolvent mixture to surround the one or more molecules of interest;

(v) lifting the pin out of the gel, the pin carrying a drop of the cosolvent mixture containing the one or more molecules of interest; and

(vi) contacting a MALDI target plate with the pin, the contacting causing the drop of cosolvent mixture containing the one or more molecules of interest to be deposited on the MALDI target plate.

2. The method of Claim 1, wherein the viscosity, surface tension and vapor pressure of the cosolvent mixture cause the drop of cosolvent mixture containing the one or more molecules of interest in the gel to adhere to the pin.

3. The method of Claim 1, wherein the viscosity, surface tension and vapor pressure of the cosolvent mixture cause the drop of cosolvent mixture containing the one or more molecules of interest to be transferred to and adhere to the MALDI target plate from the pin.

4. The method of Claim 1, wherein the viscosity, surface tension and vapor pressure of the cosolvent mixture cause the drop of cosolvent mixture containing the one or more molecules of interest to maintain its position on the MALDI target plate, without substantial evaporation.

5. The method of Claim 1, wherein the cosolvent mixture is a water and glycerol mixture of 10% to 90% by volume glycerol.

6. The method of Claim 1, wherein the cosolvent mixture is a water and polyol mixture.

7. The method of Claim 1, wherein the energizing of the pin is effected by ultrasound vibration.

8. The method of Claim 7, wherein the energy of the ultrasound vibration is between 0.1 and 5 watts per square centimeter.

9. The method of Claim 7, wherein the frequency of the ultrasound vibration is between 10 kilohertz to 1 megahertz.

10. The method of Claim 1, wherein the pin is energized for 10 seconds to 120 seconds.

11. The method of Claim 1, wherein the diameter of the pin at the tip is between 50 microns to 500 microns.

12. The method of Claim 1, wherein the drop of cosolvent mixture containing the one or more molecules of interest is between 1 to 2000 nanoliters in size.

13. The method of Claim 1, wherein the drop of cosolvent mixture containing the one or more molecules of interest is between 1 to 100 nanoliters in size.

14. The method of Claim 1, wherein the diameter of the drop deposited on the MALDI target plate is between 50 and 500 microns.

15. The method of Claim 1, further comprising the step of washing the pin in a submersion bath and repeating the steps of Claim 1 one or more times to deposit a plurality of drops on the target plate.

16. The method of Claim 15, wherein the density of drops on the target plate is between 100 and 1000 drops per square centimeter.

17. The method of Claim 15, further comprising the steps of depositing a reagent on the target plate, such that the reagent contacts the deposited drops of cosolvent mixture containing the one or molecules of interest; and
allowing the reagent to react with the one or molecules of interest in the deposited drops.

18. The method of Claim 17, wherein the depositing of the reagent is effected by a means selected from the group consisting of aerosol deposition, microprinting, pin printing, positive displacement pipetting and piezo printing.

19. The method of Claim 1, wherein the one or more molecules of interest are selected from the group consisting of proteins, peptides, DNA, RNA, nucleotides, enzymes, amino acids, substrates, catalysts, salts, buffers, cofactors, reaction-altered chemical compounds, a member of a combinatorial library of chemical compounds, a component of a drug screening reaction and combinations thereof.

20. The method of Claim 1, wherein the water in the electrophoretic gel is replaced by the cosolvent mixture by incubating the gel in the cosolvent mixture for a period of between 15-120 minutes.

21. The method of Claim 15, further comprising preparing the target plate with the deposited drops for MALDI mass spectrometry analysis by drying the deposited drops and coating the target plate with a MALDI matrix.

22. A method of running chemical reactions on a MALDI target plate comprising:

depositing drops of reactants on the target plate;
depositing a reagent on the target plate such that the reagent contacts the deposited drops; and
allowing the chemical reaction to proceed.

23. The method of Claim 22, wherein the drops are deposited on the target plate by a means selected from the group consisting of pin printing, piezo printing, microprinting and positive displacement pipetting.

24. The method of Claim 22, wherein the reagent is deposited on the target plate by a means selected from the group consisting of aerosol deposition, microprinting, pin printing, piezo printing and positive displacement pipetting.

25. The method of Claim 22, wherein the volume of each deposited drop is between 1 to 2000 nanoliters.

26. The method of Claim 22, wherein the density of drops on the target plate is between 100 and 1000 drops per square centimeter.

27. The method of Claim 22, wherein the reagents and reactants are selected from the group consisting of proteins, peptides, DNA, RNA, nucleotides, enzymes, amino acids, substrates, catalysts, salts, buffers, cofactors, reaction-altered chemical compounds, a member of a combinatorial library of chemical compounds, a component of a drug screening reaction and combinations thereof.

28. A method of preparing a sample for MALDI mass spectrometry analysis comprising the steps of:

- (i) providing a target plate having liquid drops of sample;
- (ii) drying the target plate to remove solvents from the sample drops;
- (iii) depositing a MALDI matrix onto the dry target plate;
- (iv) humidifying the target plate; and
- (v) subjecting the target plate to MALDI mass spectrometry for analysis of the sample drops.

29. The method of Claim 28, wherein the liquid sample drops comprise the reaction product of one or more reactants and one or more reagents selected from the group consisting of proteins, peptides, DNA, RNA, nucleotides, enzymes, amino acids, substrates, catalysts, salts, buffers, cofactors, reaction-altered

chemical compounds, a member of a combinatorial library of chemical compounds, a component of a drug screening reaction and combinations thereof

30. The method of Claim 28, wherein the liquid sample drops have a volume of between 1-2000 nanoliters.

31. The method of Claim 28, wherein the density of liquid sample drops on the target plate is between 100 and 1000 drops per square centimeter.

32. The method of Claim 28, wherein the drying step is effected by vacuum drying or air drying.

33. The method of Claim 28, wherein the matrix is deposited by aerosol deposition.

34. The method of Claim 33, wherein the matrix is deposited in a layer less than 50 microns in thickness.

35. The method of Claim 33, wherein less than 10 microliters of matrix is deposited per every 5 square centimeters of target plate.

36. The method of Claim 28, wherein the matrix comprises volatile solvents and a supersaturated concentration of matrix compounds.

37. The method of Claim 28, wherein said humidification step is carried out at a relative humidity of 40% to 80%, at a temperature of 22°C to 37°C for a period of 10 minutes to 120 minutes, without substantial deposition of water droplets on the MALDI matrix coating.

38. The method of Claim 28, wherein after the humidifying step the sample drops become semi-solid and the constituents of the matrix are able to admix with the reaction products in the sample drops.

39. The method of Claim 28, wherein the matrix formed provides detection of reaction products in the sample drops in the range of 1 to 50 femtomoles per sample drop.

40. The method of Claim 28, wherein after deposition of the matrix salt ions in the sample drops diffuse away from the reaction products into the surrounding matrix.

41. The method of Claim 28, wherein the reactant is a biological molecule and the reagent is a drug, for use in detecting activity of the drug on the molecule.

42. A method of depositing one or more layers of a MALDI matrix on a target plate comprising:

- (i) providing a target plate having samples thereon;
- (ii) aerosolizing the matrix; and
- (iii) spraying the aerosolized matrix on the target plate while moving the target plate.

43. The method of Claim 42, wherein the matrix is aerosolized by the use of an ultrasonic nozzle or spray nozzle.

44. The method of Claim 43, wherein the gas flow rate of the ultrasonic nozzle or spray nozzle is between 0.5 to 2.0 microliters per minute.

45. The method of Claim 44, wherein the energy of the ultrasonic nozzle is between 0.5 to 1 watt per square centimeter.

46. The method of Claim 42, wherein the matrix is deposited at a thickness of less than 50 microns.

47. The method of Claim 42, wherein the target plate is moved at a rate of 0.5 to 2 inches per second.